PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference M80596476:RLM	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. **PCT/AU2003/000814**	International Filing Date *(day/month/year)* 27 June 2003	Priority Date *(day/month/year)* 28 June 2002
International Patent Classification (IPC) or national classification and IPC **Int. Cl.** [7] G02B 26/10, A61B 18/20, A61F 9/008, B23K 26/02		
Applicant CLVR PTY LTD et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   [X] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of **14** sheet(s).

3. This report contains indications relating to the following items:

   - I [X] Basis of the report
   - II [ ] Priority
   - III [ ] Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV [ ] Lack of unity of invention
   - V [X] Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI [ ] Certain documents cited
   - VII [ ] Certain defects in the international application
   - VIII [ ] Certain observations on the international application

Date of submission of the demand 28 January 2004	Date of completion of the report 12 October 2004
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **GREG POWELL** Telephone No. (02) 6283 2308

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/AU2003/000814

I. Basis of the report

1. With regard to the **elements** of the international application:*

- [ ] the international application as originally filed.
- [X] the description, pages **1-21**, as originally filed,
  pages , filed with the demand,
  pages , received on with the letter of
- [X] the claims, pages , as originally filed,
  pages , as amended (together with any statement) under Article 19,
  pages , filed with the demand,
  pages **22-34**, received on **28 September 2004** with the letter of **28 September 204**
- [X] the drawings, pages **2/5-5/5**, as originally filed,
  pages , filed with the demand,
  pages **1/5**, received on **28 September 2004** with the letter of **28 September 2004**
- [ ] the sequence listing part of the description:
  pages , as originally filed
  pages , filed with the demand
  pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

- [ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- [ ] the language of publication of the international application (under Rule 48.3(b)).
- [ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- [ ] contained in the international application in written form.
- [ ] filed together with the international application in computer readable form.
- [ ] furnished subsequently to this Authority in written form.
- [ ] furnished subsequently to this Authority in computer readable form.
- [ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- [ ] The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. [X] The amendments have resulted in the cancellation of:
   - [ ] the description, pages
   - [X] the claims, Nos. **3**
   - [ ] the drawings, sheets/fig.

5. [ ] This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	**1, 2, 4-46**	**YES**
	Claims		**NO**
Inventive step (IS)	Claims	**1, 2, 4-46**	**YES**
	Claims		**NO**
Industrial applicability (IA)	Claims	**1, 2, 4-46**	**YES**
	Claims		**NO**

2. Citations and explanations (Rule 70.7)

Claims 1, 2 and 4-46 meet the criteria set forth in PCT Article 33(2)-(4) for novelty, inventive step and industrial applicability. The prior art published before the priority date does not disclose an optical scanning device for performing refractive eye surgery in which a quasi random voltage is applied to the scanner's piezoelectric actuator(s) so that the beam is scanned in a quasi random fashion.

The prior art documents listed in the ISR disclose the use of regular scan patterns which are not suited to eye surgery applications. Furthermore, the constructions of the disclosed scanning devices of the prior art are not suited to eye surgery, and the person skilled in the art would not be motivated to use them in eye surgery applications.

Claims

1. [Amended] An optical scanning device for use in performing refractive eye surgery on a patient, characterised in that the device comprises:

a platform,

a mirror provided on said platform to reflect an optical beam incident on said mirror,

a pivot about which said platform is able to pivot,

at least first piezoelectric actuator means to act on said platform to pivot said platform about said pivot in a first direction,

at least first resilient means to bias said platform about said pivot in a second direction opposed to said first direction,

drive means to apply a quasi random voltage to said first piezoelectric actuator means to drive said first piezoelectric actuator means,

wherein said first piezoelectric actuator means acts on said platform at a location in proximity to said pivot, to pivot said platform such that the angle at which said beam is reflected by said mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a first plane over a surface.

2. [Amended] An optical scanning device according to claim 1, characterised in that it further comprises:

second piezoelectric actuator means to act on said platform to pivot said platform about said pivot in a third direction,

second resilient means to bias said platform about said pivot in a fourth direction opposed to said third direction, and

drive means to apply a quasi random voltage to said second piezoelectric actuator means top drive said second piezoelectric actuator means,

wherein said second piezoelectric actuator means acts on said platform at a location in proximity to said pivot, to pivot said platform such that the angle at which said beam is reflected by said mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a second plane over said surface, such that said reflected beam is scannable over said surface in two dimensions.

3. [Cancelled]

4. [Amended] An optical scanning device according to claim 1 or 2, characterised in that a cap is provided over an end of said first piezoelectric actuator means that is located proximate said platform to limit sideways movement of said first piezoelectric actuator means proximate said platform.

5. [Amended] An optical scanning device according to any one of the preceding claims, 1 characterised in that the drive means to drive said first piezoelectric actuator means is a push-pull amplifier.

6. An optical scanning device according to any one of the preceding claims, characterised in that said first piezoelectric actuator means acts on said platform to push said platform and said first resilient means is compressively resilient.

7. An optical scanning device according to any one of claims 1 to 5, characterised in that said first piezoelectric actuator means acts on said platform to push said platform and said first resilient means is expandably resilient.

8. An optical scanning device according to any one of claims 1 to 5, characterised in that said first piezoelectric actuator means acts on said platform to pull said platform and said first resilient means is compressively resilient.

9. An optical scanning device according to any one of claims 1 to 5, characterised in that said first piezoelectric actuator means acts on said platform to pull said platform and said first resilient means is expandably resilient.

10. An optical scanning device according to any one of claims 2 to 9, characterised in that a cap is provided over an end of said second piezoelectric actuator means that is located proximate said platform to limit sideways movement of said second piezoelectric actuator means proximate said platform.

11. [Amended] An optical scanning device according to any one of claims 2 to 9, characterised in that the drive means to drive said second piezoelectric actuator means is a push-pull amplifier.

12. An optical scanning device according to any one of claims 2 to 9, characterised in that said second piezoelectric actuator means acts on said platform to push said platform and said second resilient means is compressively resilient.

13. An optical scanning device according to any one of claims 2 to 9, characterised in that said second piezoelectric actuator means acts on said platform to push said platform and said second resilient means is expandably resilient.

14. An optical scanning device according to any one of claims 2 to 9, characterised in that said second piezoelectric actuator means acts on said platform to pull said platform and said second resilient means is compressively resilient.

15. An optical scanning device according to any one of claims 2 to9, characterised in that said second piezoelectric actuator means acts on said platform to pull said platform and said second resilient means is expandably resilient.

16. An optical scanning device according to any one of the preceding claims, characterised in that said optical beam is a laser beam.

17. An optical scanning device according to any one of claims 2 to 16, characterised in that said first plane and said second plane are substantially mutually orthogonal.

18. [Amended] An optical scanning apparatus for use in performing refractive eye surgery on a patient, characterised in that the apparatus comprises:

a first optical scanning device,

and a second optical scanning device,

said first optical scanning device comprising

a first platform

a first mirror provided on said first platform to reflect an optical beam incident on said first mirror,

a first pivot about which said first platform is able to pivot,

first piezoelectric actuator means to act on said first platform to pivot said first platform about said first pivot in a first direction, and

first resilient means to bias said first platform about said first pivot in a second direction opposed to said first direction, and

first drive means to apply a quasi random voltage to said first piezoelectric actuator means to drive said first piezoelectric actuator means; and

said second optical scanning device comprising

a second platform

a second mirror provided on said second platform to reflect the optical beam incident on said second mirror,

a second pivot about which said second platform is able to pivot,

second piezoelectric actuator means to act on said second platform to pivot said second platform about said second pivot in a third direction, and

second resilient means to bias said second platform about said second pivot in a fourth direction opposed to said third direction, and

second drive means to apply a quasi random voltage to said second piezoelectric actuator means to drive said second piezoelectric actuator means,

wherein said first piezoelectric actuator means acts on said first platform at a location in proximity to said first pivot to pivot said first platform such that the angle at which said beam is reflected by said first mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a first plane, and said second optical scanning device is arranged such that said second mirror receives said beam reflected by said first mirror and said second piezoelectric actuator means acts on said second platform at a location in proximity to said second pivot to pivot said second platform such that the angle at which said beam is reflected by said second mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a second plane, such that said reflected beam 5 is scannable over said surface in two dimensions.

19. An optical scanning apparatus according to claim 18, characterised in that a cap is provided over an end of said first piezoelectric actuator means that is located proximate said first platform to limit sideways movement of said first piezoelectric actuator means proximate said first platform.

20. [Amended] An optical scanning apparatus according to claim 18 or 19, characterised in that the first drive means to drive said first piezoelectric actuator means is a first push-pull amplifier.

21. An optical scanning apparatus according to any one of claims 18 to 20, characterised in that said first piezoelectric actuator means acts on said first platform to push said first platform and said first resilient means is compressively resilient.

22. An optical scanning apparatus according to any one of claims 18 to 20, characterised in that said first piezoelectric actuator means acts on said first platform to push said first platform and said first resilient means is expandably resilient.

23. An optical scanning apparatus according to any one of claims 18 to 20, characterised in that said first piezoelectric actuator means acts on said first platform to pull said first platform and said first resilient means is compressively resilient.

24. An optical scanning apparatus according to any one of claims 18 to 20, characterised in that said first piezoelectric actuator means acts on said first platform to pull said first platform and said first resilient means is expandably resilient.

25. An optical scanning apparatus according to any one of claims 18 to 24, characterised in that a cap is provided over an end of said second piezoelectric actuator means that is located proximate said second platform to limit sideways movement of said second piezoelectric actuator means proximate said second platform.

26. [Amended] An optical scanning apparatus according to any one of claims 18 to 25, characterised in that the second drive means to drive said second piezoelectric actuator means is a second push-pull amplifier.

27. An optical scanning apparatus according to any one of claims 18 to 26, characterised in that said second piezoelectric actuator means acts on said second platform to push said second platform and said second resilient means is compressively resilient.

28. An optical scanning apparatus according to any one of claims 18 to 26, characterised in that said second piezoelectric actuator means acts on said second platform to push said second platform and said second resilient means is expandably resilient.

29. An optical scanning apparatus according to any one of claims 18 to 26, characterised in that said second piezoelectric actuator means acts on said second platform to pull said second platform and said second resilient means is compressively resilient.

30. An optical scanning apparatus according to any one of claims 18 to 26, characterised in that said second piezoelectric actuator means acts on said second platform to pull said second platform and said second resilient means is expandably resilient.

31. An optical scanning apparatus according to any one of claims 18 to 30, characterised in that said optical beam is a laser beam.

32. An optical scanning apparatus according to any one of claims 18 to 31, characterised in that said first plane and said second plane are substantially mutually orthogonal.

33. A laser apparatus characterised in that it comprises:

a laser to emit an optical beam, and

an optical scanning device according to any one of claims 1 to 17,

wherein the reflected beam is scannable over the surface to perform material processing of said surface by the reflected beam and the optical path of the reflected beam from said optical scanning device to said surface is substantially one metre or more in length.

34. [Amended] A laser apparatus for use in performing refractive eye surgery on a patient, characterised in that the apparatus comprises:

a laser to emit an optical beam, and

an optical scanning device comprising

a platform,

a mirror provided on said platform to reflect a said optical beam incident on said mirror,

a pivot about which said platform is able to pivot,

first piezoelectric actuator means to act on said platform to pivot said platform about said pivot in a first direction,

first resilient means to bias said platform about said pivot in a second direction opposed to said first direction,

first drive means to apply a quasi random voltage to said first piezoelectric actuator means to drive said first piezoelectric actuator means,

second piezoelectric actuator means to act on said platform to pivot said platform about said pivot in a third direction,

second resilient means to bias said platform about- said pivot in a fourth direction opposed to said third direction,

second drive means to apply a quasi random voltage to said second piezoelectric actuator means to drive said second piezoelectric actuator means,

wherein said first piezoelectric actuator means acts on said platform at a location in proximity to said pivot, to pivot said platform such that the angle at which said beam is reflected by said mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a first plane and said second piezoelectric actuator means acts

on said platform at a location in proximity to said pivot, to pivot said platform such that angle at which said beam is reflected by said mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a second plane, such that said reflected beam is scannable over said surface in two dimensions to thereby scan the reflected beam over the surface to perform material processing of said surface by the reflected beam and the optical path of the reflected beam from said optical scanning device to said surface is substantially one metre or more in length.

35. A laser apparatus according to claim 33 or 34, characterised in that it further comprises a second mirror to reflect the reflected beam reflected by said mirror of said optical scanning device prior to said reflected beam being reflected to said surface.

36. A laser apparatus according to claim 35, characterised in that it further comprises a third mirror to receive the reflected beam from said second mirror and said third mirror is arranged to reflect said beam to said surface.

37. A laser apparatus according to any one of claims 33 to 36, characterised in that said laser apparatus is a refractive eye surgery laser apparatus, and the surface on which the material processing is performed by the reflected beam is the eye of a patient on which the refractive surgery is performed by the reflected beam.

38. [Amended] A laser apparatus comprising:

a laser to emit an optical beam, and

an optical scanning apparatus according to any one of claims 18 to 32,

wherein the reflected beam is scannable over a surface to perform material processing of said surface by the reflected beam and the optical path of the reflected beam from said second optical scanning device to the said surface is substantially one metre or more in length

39. [Amended] A laser apparatus for use in performing refractive eye surgery on a patient, comprising:

a laser to emit an optical beam,

a first optical scanning device, and

a second optical scanning device,

said first optical scanning device comprising

a first platform

a first mirror provided on said first platform to reflect an optical beam incident on said first mirror,

a first pivot about which said first platform is able to pivot,

first piezoelectric actuator means to act on said first platform to pivot said first platform about said first pivot in a first direction, and

first resilient means to bias said first platform about said first pivot in a second direction opposed to said first direction, and

first drive means to apply a quasi random voltage to said first piezoelectric actuator means to drive said first piezoelectric actuator, and

said second optical scanning device comprising

a second platform

a second mirror provided on said second platform to reflect the optical beam incident on said second mirror,

a second pivot about which said second platform is able to pivot,

second piezoelectric actuator means to act on said second platform to pivot said second platform about said second pivot in a third direction, and

second resilient means to bias said second platform about said second pivot in a fourth direction opposed to said third direction, and

second drive means to apply a quasi random voltage to said second piezoelectric actuator means to drive said second piezoelectric actuator means,

wherein said first piezoelectric actuator means acts on said first platform at a location in proximity to said first pivot to pivot said first platform such that the angle at which said beam is reflected by said first mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a first plane, and said second optical scanning device is arranged such that said second mirror receives said beam reflected by said first mirror and said second piezoelectric actuator means acts on said second platform at a location in proximity to said second pivot to pivot said second platform such that the angle at which said beam is reflected by said second mirror is altered to alter the path of the reflected beam to thereby scan the reflected beam in a quasi random fashion in a second plane, such that said reflected beam is scannable over said surface in two dimensions to thereby scan the reflected beam over a surface to perform material processing of said surface by the reflected beam and the optical path of the reflected beam from said second optical scanning device to the said surface is substantially one metre or more in length.

40. [Amended] A laser apparatus according to claim 38 or 39, characterised in that a third mirror is provided to reflect the reflected beam reflected by said second mirror prior to said reflected beam being reflected to said surface.

41. [Amended] A laser apparatus according to claim 40, characterised in that a fourth mirror is provided to receive the reflected beam from said third mirror and said fourth mirror is arranged to reflect said reflected beam to said surface.

42. [Amended] A method of scanning an optical beam, in at least a first plane, over a surface using an optical scanning device according to any one of claims 1 to 17, characterised in that it comprises

determining a required location for the optical beam to be incident on said surface,

determining whether a positive or negative change to the voltage applied to a said piezoelectric actuator means is required to pivot said platform to a required position corresponding to the said required location,

comparing the existing position of said platform and the voltage applied to said piezoelectric actuator means with the required position of said platform,

calculating the required voltage to be applied to said piezoelectric actuator means corresponding to the required position of said platform,

applying the said required voltage to said piezoelectric actuator means to move said platform to said required position such that the optical beam is incident on said surface at the said required location.

43. [Amended] A method according to claim 42, characterised in that said required position of said platform and the corresponding required voltage to be applied to said piezoelectric actuator means are recorded for use in determining the voltage to be applied to said piezoelectric actuator means for the next location at which said optical beam is to be incident on said surface.

44. [Amended] A method according to claim 42 or 43, characterised in that the steps of the method recited in claim 42 or 43 are carried out on each of the first piezoelectric actuator means and the second piezoelectric actuator means to pivot said platform to the required position for the optical beam to be incident on said surface at said required location, to thereby scan the optical beam in two planes, such that the optical beam is scannable in two dimensions over said surface.

45. [Amended] A method of scanning an optical beam, in two planes, over a surface using an optical scanning apparatus according to any one of claims 18 to 32, characterised in that it comprises

determining a required location for the optical beam to be incident on said surface,

determining whether a positive or negative change to the voltage applied to each of said first piezoelectric actuator means and said second piezoelectric is required to pivot each said platform to a required position corresponding to the said required location,

comparing the existing position of each said platform and the voltage applied to said first piezoelectric actuator means and said second piezoelectric means, respectively, with the required position of each said platform,

calculating the required voltage to be applied to said first piezoelectric actuator means and said second piezoelectric means, respectively, corresponding to the required position of each respective said platform,

applying the said required voltage to said first piezoelectric actuator means and said second piezoelectric actuator means, respectively, to move each said platform to the respective said required position such that the optical beam is incident at the said required location.

46. A method according to claim 45, characterised in that said required position of each said platform and the corresponding required voltage to be applied to said first piezoelectric actuator means and said second piezoelectric actuator means, respectively, are recorded for use in determining the voltage to be applied to said first piezoelectric actuator means and said second piezoelectric actuator means, respectively, for the next location at which said optical beam is to be incident on said surface.

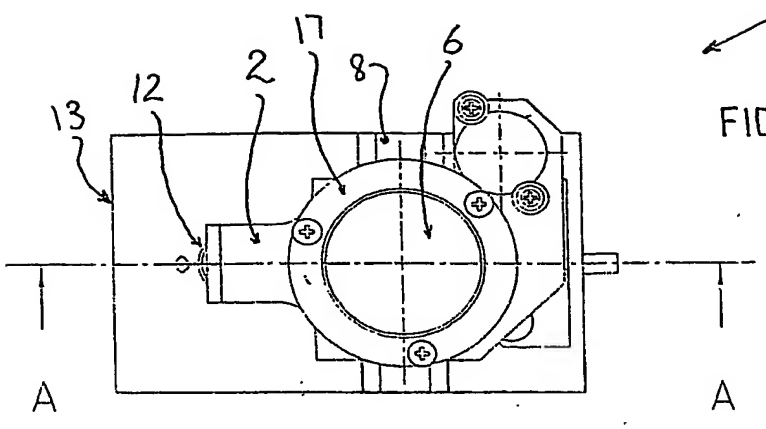

FIGURE 1a

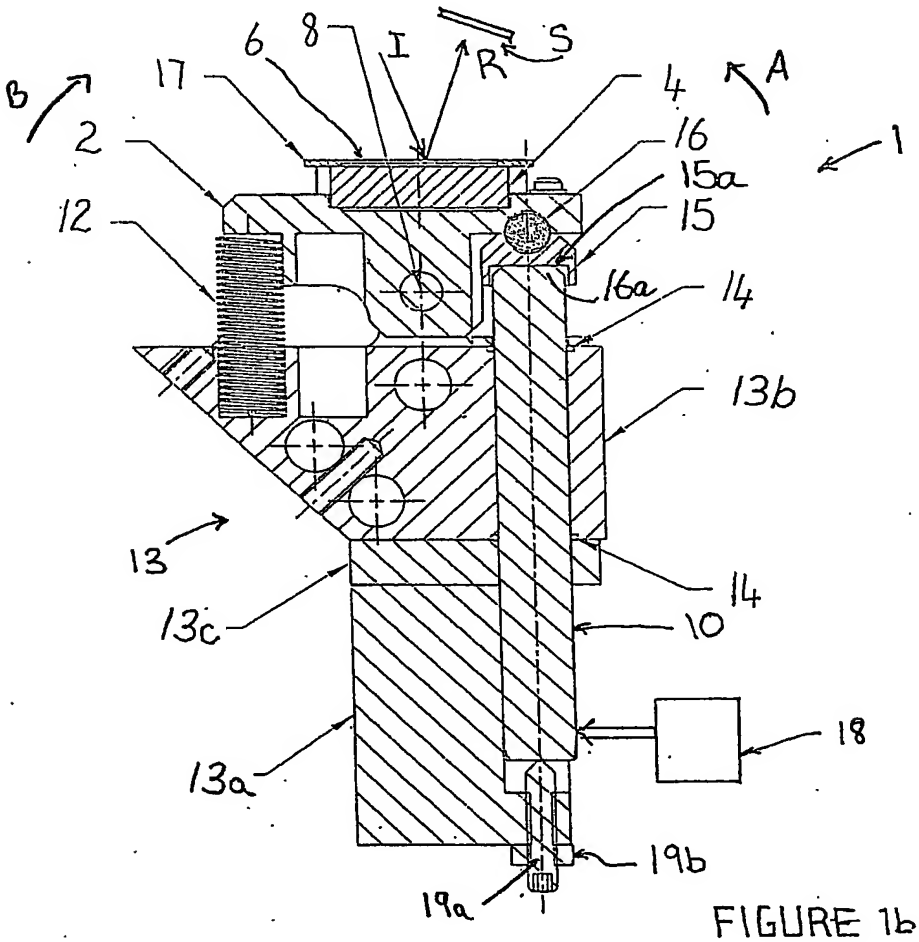

FIGURE 1b

AMENDED SHEET
IPEA/AU